

REMARKS

The present invention provides a compact relatively inexpensive measuring composite electrode that can operate for example, as a microelectrode to measure trace amounts of a sample. The electrode housing is formed as a double glass pipe with the inner pipe integrally fused to the outer housing so that it is cantilevered co-axially with the outer housing glass pipe. A liquid connecting section or junction 9 can be provided in the outer hollow glass pipe as seen, for example in the cross section of Figure 3B.

An elongated material is compressed intermittently between the outer surface of the inner glass pipe and the inner surface of the outer glass pipe. The elongated material can absorb a liquid such as a reference electrode internal liquid and can be further immersed in the annular sealed space containing the reference electrode liquid. Since the inner glass pipe is cantilevered co-axially, the elongated material has a degree of flexibility that can be compressed between the inner surface of the outer hollow glass pipe and the outer surface of the inner hollow glass pipe. Such a construction provides support for the double glass pipe composite electrode.

A problem of small bubbles in the reference electrode liquid can provide an electrical disconnect between the connecting section junction 9 and a reference electrode that is positioned at a distance from junction 9. In the preferred embodiment, an enlarged upper hollow glass pipe surrounds an enlarged inner hollow glass pipe and the reference electrode is positioned within the reference electrode liquid at that location.

Since the electrode flexible material can include a string-like member that can be helically wound in the annular space, it is possible to have a linear conductivity even if bubbles exist in the electrode probe. Since the flexible material absorbs the reference electrode liquid in a location in which a bubble may leave a gap in contact with the liquid reference electrode, the

string-like material bridged the gap with the absorbed reference electrode liquid in the flexible material until the flexible material again engages freestanding reference electrode liquid.

Thus, the line of conductivity is not necessarily helical but only bridged around any gaps or bubbles by the absorbed reference electrode liquid in the flexible material.

The present invention not only provides an improved composite electrode, but it also permits a relatively economical manufacturing of a true double pipe glass fused electrode probe, as shown in Figures 3A and 3B. The flexible material assists in positioning and aligning the inner glass pipe within the outer glass pipe, as shown in Figure 3B. The flexible material, however, remains in the finished product and contributes to the operability and the stability of a resulting electrode probe in a unique manner not taught nor recognized by the art of record.

The Office Action asserted that Claims 5-7, 9-14, 16-18 and 20-22 were obvious over a combination of our admitted prior art (Figures 5A, 5B and Figure 4) when taken with *Bukamier* (U.S. Patent No. 4,128,468).

The *Bukamier* reference taught a pair of concentric parallel glass tubes offset from each other by a Teflon plug having grooves for receiving sealing O rings. As noted in Column 3, Lines 17-30, the preferred embodiment used a pair of two spaced sealing annulus (Teflon cylinders with a hollow center) to seal an annular space and additionally provide small salt bridges around O rings. As noted in Column 5, the diameter of the bore in the annulus encompasses and embraces the inner tube.

The Teflon plug has a lesser diameter than the diameter of the outer glass member and thereby utilizes O ring seals. The O ring seals purportedly can also assist in forming a salt bridge with a large surface area of contact between the Teflon plug and the inner tube to enhance the sealing effect of the inner tube.

The *Bukamier* reference recognized that bubbles can cause a program in a desired physical liquid to liquid contact and a salt bridge plug would permit some independence from any rotational orientation of the respective glass tubes when placed in a sensor environment.

As can be readily appreciated, the *Bukamier* reference teaches away from any integral glass fusion between an inner glass pipe and an outer glass pipe and instead uses a pair of Teflon plugs with a bore to contact the outer surface of the inner housing wall and a pair of O rings to physically contact the inner surface of the outer housing. The Teflon material has the capacity to permit a small salt bridge around the respective O rings, whereby the reference electrode can be positioned between the Teflon plugs and an annular space.

Claim 5 has been amended to define a relationship between the inner pipe and the outer pipe spaced from each other by a string-like member with liquid absorption characteristics. The *Bukamier* reference does not teach a Teflon plug as spacing the outer pipe from the inner pipe. Since the Teflon plug grasps the inner pipe, O rings are necessary for the undersize diameter to seal the inner diameter of the outer housing. Additionally, there is a limit to the compression since it is highly desirable to maintain a salt bridge around the respective O rings, which places a limitation on the amount of compression force.

While the Office Action asserted a combination of our admitted prior art with the *Bukamier* reference, it is clear that the *Bukamier* reference is seeking a relatively inexpensive composite electrode utilizing Teflon plugs or cylinders with O rings and directly teaches away from glass fuses in the inner outer pipes. In fact, the *Bukamier* reference indicates either glass or plastic can be utilized since only cylindrical tubes are involved.

Claim 5, as currently amended, defines not only a string-like member which would not describe the Teflon plugs with the O rings, but further that the string-like member is spirally wound around the inner pipe.

As can be further appreciated, Claim 5 had already indicated that the inner pipe is spaced from the outer pipe by the string-like member and that the inner pipe, initially, was connected to the outer pipe to form the annular space.

The Office Action in asserting that the Teflon plugs could constitute the elongated member, further contended that the exact shape and porous material used was not vital to its function. Utilization of a string-like helically wound member not only supports and tempers any vibrations or shock to increase the life of a composite electrode probe but further performs an important function of providing a continued bridge of reference electric liquid to ensure that any bubbles will not break the conductive electrical conductive path.

Additionally, any bubbles would also be distributed by the helical winding in the string-like material that absorbs the reference electrode liquid to ensure a continued liquid to liquid interface linearly along the length of the annular space.

The Office Action's further contention that the exact shape and porous material used is not vital to its function, fails to appreciate the multiple advantages of not only support, removal of the affected bubbles, and providing continuity of the electrical path of our claims.

The asserted combination of the *Bukamier* disclosure with that of the admitted prior art does not suggest or provide an apparent reason for such a combination to justify a rejection under 35 U.S.C. §103.

Often, it will be necessary . . . to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background

knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.

KSR Int'l Co. v. Teleflex Inc., 127 S. Ct. 1727, 1740-41 (2007).

Claims 8 and 15 were further rejected over a combination of the *Bukamier* reference in view of either *Christner et al.* (U.S. Patent No. 5,346,606) or *Benton* (U.S. Patent No. 6,054,031) under 35 U.S.C. §103.

The *Christner et al.* reference purportedly is an invention directed to an electrode sensor that can reduce plugging in problems when large junction surfaces were employed. See Column 1, Lines 45-46. Another problem addressed was contamination of the internal reference electrode liquid with a specimen fluid.

Thus, the solution proposed by the *Christner et al.* invention was to provide a spiral cut in an outer surface of a plug that like the *Bukamier* reference, spaced an internal inner pipe from an outer cylindrical pipe. The plug itself as shown for example in Figures 2A-2C, also houses a reference electrode. The reference electrode is separated from the specimen fluid by the plug, thereby reducing migration of the specimen fluid to contaminate the reference electrode liquid and electrode. The spiral cut shown on the exterior of the plugs (the plugs for example being made of wood), are filled with an electrically non-conductive ion impermeable material such as an epoxy, to thereby provide a spiral barrier.

Any migration through the interior portion of the wood such as through capillaries, must take a circuitous path around the spiral portions. See Column 5, Lines 28-35.

The Office Action had contended that again the exact shape or porous material in the spiral shaped plug is not critical in view of our claims. In this regard, the *Christner et al.* reference is simply cited to modify the *Bukamier* reference with the spiral grooves. The spiral

grooves, however, were only used to extend a torturous path for the migration of ions to retard contamination.

As can be appreciated, our Claim 8 defines a cotton string which is clearly not taught by either *Christner et al.* nor the *Bukamier* reference. Nor is there any teaching of a string-like member spiraling around the inner pipe.

Claim 15 also is defined as a string-like member helically wound between the inner glass pipe and the outer hollow glass pipe.

Christner et al. was not concerned with any bubble problem and the spiral configurations in essence created a solid plug with the spiral being an ion impermeable spiral barrier. Thus, the *Christner et al.* reference does not teach the features and the structural advantages set forth in our current claims to achieve the purposes of our improved composite electrode.

The *Benton* reference disclosed an outer housing of a cylindrical configuration with an inner housing or body member to create, in essence, an elongated junction configuration. See Column 3, Lines 37-53.

Rather, the junction exists as a filament-like helix of internal solution filling a void between the outer surface of body 34 and the inner surface of housing 32. This reduces both cost and assembly time over that required by prior electrochemical sensors which implemented the junction using an additional, discrete component.

The void defining the helical junction 50 is preferably filled with an appropriate internal junction material such as a solution or a solid material appropriate to the particular function of the electrochemical sensor 30. The internal junction material is preferably a permeable material. By permeable, it is meant that the junction material is generally porous to solids and solutes. In a preferred embodiment, the junction material is a gel or solid electrolyte material which is physically "thick" or "tight" to slow the general mobility of ions.

(underline added.)

To place this into proper context, a junction or liquid connecting section of our current claims would apparently be constituted by the helical grooves or threads in the inner body of *Christner et al.* As can be further appreciated, the thread on the inner body 34' also directly contacts the inner surface of the outer housing 12.

As noted in Column 5, Lines 60-65, the outer housing 32 and the inner body 34 do not appear to be glass since they are preferably molded or cast and the only important portion is providing a long channel of a relatively small cross section for providing ionic continuity as an elongated junction. See also Column 1, Lines 62-63.

In summary, the provision of a helical junction 50 filled with a gel or solid electrolyte material for slowing the mobility of ions does not teach a string-like material submerged in a reference electrode liquid to address the bubble problem and specifically provide support for a cantilevered co-axial inner glass tube wherein the string provides intermittent contact between the inner housing of the outer tube and the outer housing of the inner tube.

The issue of a salt bridge is not addressed in the spiral shaped member of *Christner et al.*, since the actual teaching of *Christner et al.*, is the elongated spiral junction itself.

Claim 19 was rejected as obvious over the admitted prior art in view of *Bukamier and West et al.* (U.S. Patent Publication 2003/0150726). The *West et al.* reference again discloses a pair of open cylindrical tubes with bottom seals and upper seals for spacing the tubes and supporting an annular reference electrolyte.

The Office Action citations of Paragraph 0053 simply referred to a storage sleeve 22 in Figure 5 that could store a finished probe so that it does not dehydrate or change status including absorbing moisture. An absorbent material can be used in the storage depository to maintain a desired moisture level.

The teachings of Paragraph 0069 again simply refers to the necessity to have a properly stored and hydrated Ph sensitive glass to be an operative component. The provisions of the structure of our Claim 19 relates to the finished components in an electrode assembly, not to a storage mode of operation.

Finally, Claims 9, 12, 18 and 19 were held to be obvious over a combination of the admitted prior art and the *West et al.* reference. As noted above, the *West et al.* reference does not teach the features defined in our presently amended claims, nor does it recognize the problems resolved in our present invention.

As noted in the cited MPEP §2141 (pg. 2100-120):

When applying 35 U.S.C. §103, the following tenets of patent law must be adhered to:

- (A) The claimed invention must be considered as a whole;
- (B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination;
- (C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention; and
- (D) Reasonable expectation of success is the standard with which obviousness is determined.

Hodosh v. Block Drug Co., Inc., 786 F.2d 1136, 1143 n.5, U.S.P.Q. 187 n.5 (Fed. Cir. 1986). (Emphasis added.)

In summary, the *Bukamier* reference does not teach the concept of a string-like member, nor the capability of such a structure in performing the function of a centering support of a cantilevered inner glass pipe to define an internal reference liquid path and to prevent any disruption of an electrical connection between a comparison or reference electrode and a liquid connecting section or junction.

The secondary references like the *Bukamier* reference, are not concerned with the problems in the admitted prior art and in fact suggest and teach an alternative structural arrangement by providing parallel hollow glass tubes with plugs having O rings supporting and sealing the tubes together.

The *Christner et al.* reference actually teaches a spiral non-porous section to act as a barrier to ion transmission, while the *Benton* reference teaches specifically what its title is. "Composite Channel Junction." That is, an elongated junction that can be filled with a gel to impede ion movement. The helical threads actually teach an extended open liquid ionic junction.

The newly drafted Claim 25 utilizes the sixth paragraph of 35 U.S.C. §112 to define means for preventing a disconnect in electrical conduction by any formation of bubbles by a specific configuration of an elongated member with hydrophilicity for the reference electrode internal liquid for intermittently contacting the outer surface of an inner glass pipe and the inner surface of an outer glass pipe.

Newly drafted independent Claim 28 specifically defines a pair of hollow glass pipes, the inner hollow glass pipe being integral with the outer hollow glass pipe and cantilevered co-axially to form an annular inner space. A liquid connecting section is provided adjacent one end of the outer hollow glass and a flexible reference electrode internal liquid absorbing material is positioned between the inner surface of the outer hollow glass pipe and the outer surface of the inner hollow glass pipe to space the inner hollow glass pipe from the outer hollow glass pipe and to provide a linear conductive path from the liquid connecting section or junction through the annular internal space with reference electrode internal liquid and to provide a flexible support between the outer hollow glass pipe and the inner hollow glass pipe.

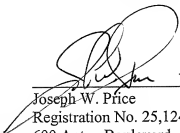
The dependent claims therefrom also provide additional features that are neither taught nor suggested by any combination of the references of record.

It is believed that the case is now in condition for allowance and early notification of the same is requested.

If the Examiner believes a telephone interview will help further the prosecution of this case, the undersigned attorney can be contacted at the listed telephone number.

Very truly yours,

SNELL & WILMER L.L.P.



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